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CRUISE OF THE U. S. FISHERIES SCHOONER "GRAMPUS" IN THE GULF STREAM DURING JULY, 1908, WITH DESCRIPTION OF A NEW MEDUSA (BYTHOTIARIDAE).

BY HENRY B. BIGELOW.

WITH ONE PLATE.

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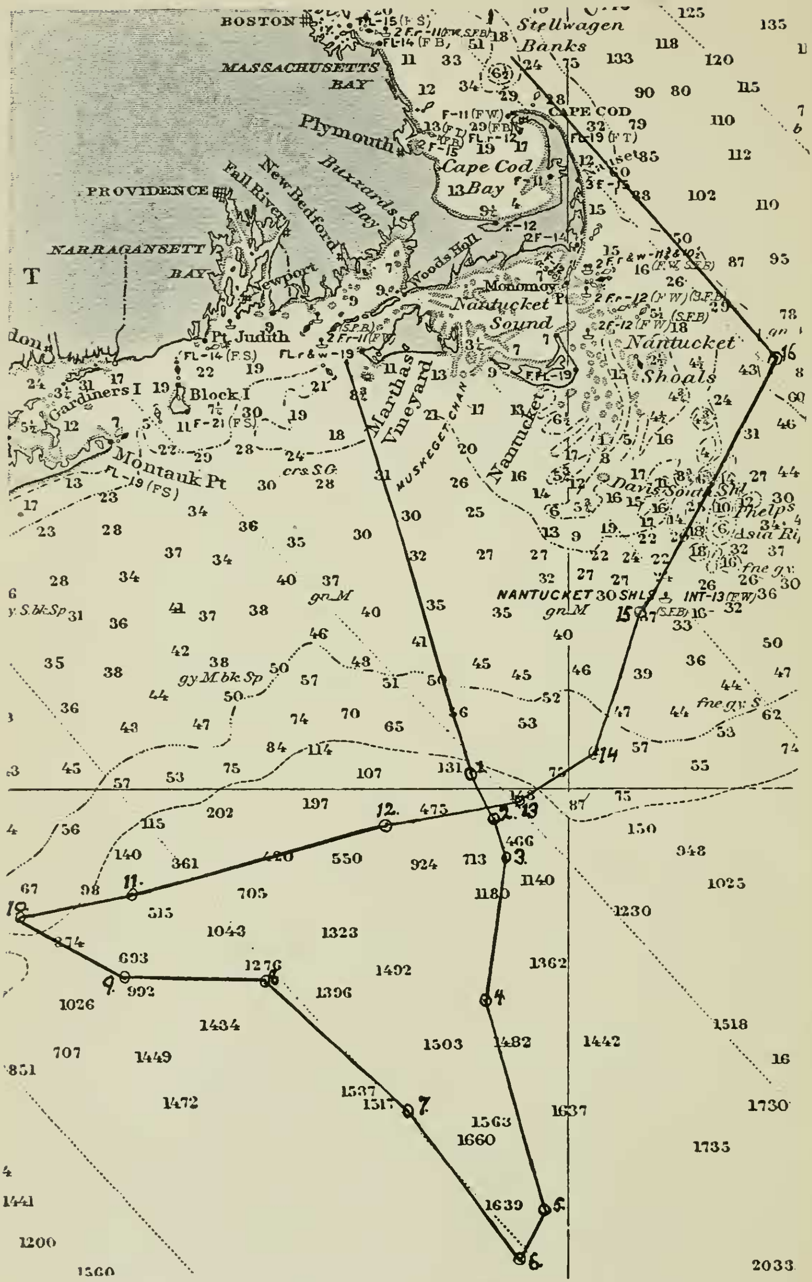
No. 12. *Cruise of the U. S. Fisheries Schooner "Grampus" in the Gulf Stream during July,* 1908, *with description of a new Medusa (Bythotiaridae).* By Henry B. Bigelow.

From July 7 to July 18, 1908, the schooner "Grampus" was detailed by the Hon. G. M. Bowers, U. S. Commissioner of Fisheries, for work in the Gulf Stream, under the direction of the Museum of Comparative Zoölogy.

The main purpose of the cruise was to investigate the fauna of the intermediate waters of the Stream, a branch of study which has become of great interest since the demonstration, by the recent deep-sea expeditions of the "Valdivia," the "Princess Alice," and the "Albatross," of the existence of an important intermediate pelagic fauna, distinct on the one hand from the surface fauna and on the other from the bottom fauna. This intermediate fauna was collected in great abundance by the expedition of the "Albatross" to the Eastern Pacific in 1904–1905 in the course of the Humboldt current, and in all probability it is abundant in the Gulf Stream also ; especially since certain of its characteristic components, *e. g.*, the Scyphomedusae Atolla and Periphylla, have been taken repeatedly in this region in the trawl. Up to the present time, though much surface collecting has been done in the Gulf Stream and the bottom thoroughly explored with the trawl, its intermediate depths have been almost entirely neglected.

A second purpose was a trial of the deep-sea trap devised by the Prince of Monaco. This apparatus has been employed with great success off the European coast, but had not been tried previously on this side of the Atlantic. In addition to these two main objects surface collections were made on favorable occasions and intermediate as well as surface temperatures taken.

The "Grampus" has no reeling engine, and to supply this deficiency she was equipped for the occasion with a gasoline hoisting motor, constructed by the Olds Engine Co. This apparatus, of three horse power and geared to hoist by means of a gipsy head at the rate of about 100 feet per minute, proved entirely satisfactory. From the gipsy head the wire rope was led to a hand reeling winch. The collecting apparatus consisted of several five-foot open nets, of the "Albatross" pattern, a



Route and Stations of the "Grampus," July, 1908.

Tanner closing net of improved pattern, a Petersen closing net, the Monaco trap, and the usual complement of dip-nets and small surface tow nets. For sounding a hand Tanner machine was installed. Deep-sea thermometers were loaned by the Bureau of Fisheries.

Capt. G. F. O. Hanson, commanding, and the officers and crew were indefatigable in their attention to the work of the Cruise. Drs. L. J. Cole and J. L. Bremer accompanied me on the trip and kindly assisted in the care of the collections.

The "Grampus" set sail from Gloucester Harbor on the afternoon of July 7. On the following day we anchored in Vineyard Haven to take on board some apparatus from the Station of the Bureau of Fisheries at Woods Hole, getting under way again that evening. We purposed to make our first trial of the Monaco trap on the continental slope, near the inner edge of the Gulf Stream, and accordingly on July 9 soundings were taken at 2 P. M. in 70 fathoms and in 200 fathoms, to develop the slope. A third sounding a few miles further south showed 260 fathoms and the trap was set in about 300 fathoms. While the set was in progress an intermediate haul with the five-foot open net was made. From the Station, lat. 39° 49′ N., long. 70° 16′ W., we ran our first leg in a south-southeasterly direction for about 80 miles, to lat. 38° 33′, long. 70° 08′ (Station 6), thus making a representative section of the northern part of the Stream. On this run three intermediate hauls were made. Our second leg was run from this point on a northwesterly course, for about 120 miles, to Station 10 (lat. 39° 36′, long. 72° 15′), with three intermediate hauls. Near this point, being once more over the edge of the continental slope, we planned to make a second set of the Monaco trap. Accordingly, after sounding in 51, 300, 200, and 190 fathoms, the trap was set on July 12, lat. 39° 54′, long. 70° 44′, in 455 fathoms, the bottom at that point being green mud with a few Globigerinae. During this set, as at Station 3, an intermediate haul was made. From this Station our third leg was run in a northeasterly direction parallel to the continental slope, along the inner edge of the Stream until we intersected leg 1, near Station 3, a distance of about 90 miles, during which one intermediate haul was made. On the completion of this leg the work in the Stream proper was completed, the triangle thus executed having given us a survey of a typical region. However, in order to compare the pelagic fauna of the cold water over Nantucket shoals with that of the warm waters of the Stream, work was prosecuted on the homeward trip over the shoals and around Cape Cod, hauls being made in regions where the surface temperatures were 64° and 65°, respectively.

Throughout the Cruise the weather was excellent and, the winds favoring, we accomplished the work mapped out with greater rapidity than could fairly have been expected. On July 18 the "Grampus" returned to Gloucester.

The Surface Fauna.

During the Cruise surface hauls were made at five stations, and in addition specimens were collected in the hand nets at several other localities, while, of course, surface forms were also taken in abundance in the intermediate hauls with open nets. The most interesting feature of the surface fauna was the extraordinary abundance of Salpae in the warm water. Salpae were first encountered on July 9, a few miles south of Gay Head, where scattered individuals and a few chains were seen floating on the surface. As we approached the continental slope and the surface temperature grew higher, they became steadily more numerous, until by the time we had fairly entered the Gulf Stream they were present in greater abundance than I have ever seen them before, even in the Humboldt current where the "Albatross" encountered them in dense swarms. Throughout the three legs which we ran in the region of the Stream their quantity was enormous, and it was not until we once more entered the colder waters over Nantucket shoals on our homeward run that their numbers began to diminish. Owing to the calmness of the weather for several successive days we had an excellent opportunity to observe them. On all sides of the vessel the surface was covered with chains, up to six feet in length, as well as with scattered single individuals. And as far as the eye could penetrate, at least five fathom, they were so abundant that during several hours' watching over the stern there was never a time when several chains were not in sight beside the rudder post at once. The quantitative results of several surface hauls may give a definite notion of the abundance of Salpae. At Station 5, where we made a surface haul of ten minutes' duration, the two-foot net was filled to the brim with Salpae, and its bridle and rope festooned with chains. On several successive occasions, also, the two-foot net was completely filled after towing a few minutes. With the five-foot net it was impossible to make any surface hauls because the weight of the load of Salpae which were captured almost at once endangered the net. Even in the intermediate hauls considerable quantities were taken. Thus, in hauls with the five-foot open net, at 150 fathoms (Station 7) between three and four quarts, and at 200 fathoms to surface (Station 13) eight quarts of Salpae were taken. In these, and in every other intermediate haul, the lower part of the net was completely filled with them. The quantities in these hauls were, however, much less than would have been taken in surface hauls of like duration, indeed no more than would be gathered on the surface by the five-foot net in two or three minutes. This fact indicates that the Salpae were chiefly limited to a comparatively shallow surface zone, probably not more than 20 or 30 fathoms, and that it was on its passage downward and upward through this zone, not while being towed horizontally at from 150 to 300 fathoms, that the intermediate net captured the load of Salpae which it invariably yielded.

The diminution in the number of Salpae noted on leaving the warm water of the Gulf Stream on our homeward trip was sudden. Thus while at Station 13, lat. 39° 57′, long. 70° 13′, eight quarts were taken in an intermediate haul; in lat. 40° 7′, long. 69° 59′ (Station 14), where the surface temperature had dropped from 72° to about 70° the diminution was already marked, and at Station 15, only twenty-seven miles distant, but with a surface temperature of 64°, only two or three individuals were seen and none taken during the half hour occupied in making a tow with the five-foot net at 15 fathoms. After this point, on the run northward around Cape Cod, only a few scattered individuals were observed. I may call attention here to the fact that Salpae were unusually abundant at Woods Hole throughout the summer of 1908.

The abundance of Salpae caused the quantitative richness of the surface Plankton of the Gulf Stream to be extremely high. But, as is usually the case when any one large organism is swarming throughout a considerable period, the yields of the surface hauls were qualitatively correspondingly poor. This poverty was progressive throughout the cruise, a fact suggesting that we reached the Stream early in the swarm-period of the Salpae, and that as time progressed these rapacious organisms devoured most of the smaller forms which usually compose the bulk of the surface Plankton. Indeed, considering the volume of water strained by them, but few of the smaller copepods, pteropods, or protozoans could be expected to escape. An unusual transparency of the surface water was connected with the poverty of the finer Plankton. For example, at Station 9, where it happened that fewer Salpae than usual surrounded the ship, the five-foot net was distinctly visible at a depth of 20 fathoms.

The Plankton, aside from the Salpae, presented no unusual features, except in the absence of certain forms which are usually common. Very few pelagic fishes were taken, among them being Cyclothone, and several mictophids. Among crustaceans, schizopods, particularly Euphausiidae and Mysis, were noticeable for their abundance. Several species of amphipods occurred regularly: hyperids were common, as was Phronima of three species associated with Doliolum. Lucifer was taken on several occasions. Several species of isopods were collected; while copepods, among them Saphirina, and ostracods of several species were an important constituent of every haul. Crustacean larvae, on the other hand, were conspicuously rare, only a few megalops stages, a few stomatopod larvae, and a single phyllosome larva being taken. Annelids, even Tomopteris, usually so common in warm waters, were noticeably absent. Perhaps the best series in the collection is afforded by the pteropods, of such genera as Hyalea, Spirialis, Atlanta, and Limacina, but other pelagic molluscs were almost absent, no heteropods, and only a single specimen of Janthina being taken. Sagitta was fairly well represented, but only very few Appendiculariae were captured. There were but few coelenterates taken, and those few all belong to species widely distributed in tropical and subtropical waters. Among siphonophores I may mention Physalia, Crystallomia, Diphyes, Galeolaria, Abyla, and Rhyzophysa. The only Medusa found on the surface in the Stream was one specimen of *Rhopalonema velatum*, and the only ctenophores were a few *Beroe ovata*. The scarcity was even more striking in the case of the finer Plankton, the quantity of rhizopods, radiolarians, and diatoms in any of the hauls being extremely small. Associated with this scarcity is not only the clearness of the water already noted but the fact that throughout the cruise very little phosphorescence was to be seen.

In addition to the smaller organisms certain other surface forms deserve brief notice. Gulfweed was first noted a few miles southeast of Gay Head. It was seen in small masses so long as we were within the influence of the Gulf Stream; but after we left the Stream, as shown by the decrease of the surface temperature to 64°, no more was observed. Several small collections of Gulfweed were made, and from them the usual species of crustaceans and other animals obtained; among them I may call especial attention to Balistes, Lepas, plumularian hydroids and Obelia. A floating box yielded a rich haul, including a small Loggerhead turtle, and many specimens of a large eolid with chocolate papillae. A most interesting capture is that of two specimens of a large octopoid taken on the surface in lat. 39° 25′ N., long. 71° 48′ W. The specimens were floating dead when seen, but both were in fairly good condition and were preserved. In the larger the central disc between the bases of the arms was about 18 inches in diameter, and the tentacles were about two feet long. Both specimens were of a deep chocolate-red color. Judging from the similarity between the pigment and that of many intermediate organisms it is not unlikely that this cephalopod belongs to the intermediate fauna, and that the specimens were brought to the surface by some horizontal disturbance of the water.

Among larger surface forms flying fish were frequently noted so long as we were in the warm waters of the Stream, as were several schools of whales and porpoises. The only birds observed in the Stream were Wilson's petrels (*Oceanites oceanicus*) and the Greater Shearwater (*Puffinus gravis*).

As already noted, surface hauls were made on the homeward trip around Cape Cod for the purpose of comparing the Plankton of the cold waters with that of the Gulf Stream, and the usual characteristic differences were noted. At Station 15, a haul with the five-foot open net was made at 15 fathoms and at the surface. At this station great masses of small pink copepods were taken, as well as several specimens of the characteristic northern *Clione limacina* (Phipps), and a large quantity of Spirialis. Many small specimens of *Cyanea arctica* were noted on the surface, and several collected. The sudden absence of Salpae on passing into the colder water has already been noted. Although no remarkable forms were taken, the contents of this and the ensuing hauls, which contained much the same species, are of considerable interest from the faunistic standpoint, as showing how sudden is the demarcation between the surface faunae of the cold and warm waters off Cape Cod, the yield being composed of species entirely different from those taken in the Gulf Stream. The surface temperature at this station had already dropped to 64° and at 30 fathoms it was only 54.5°. From this point northward no more Sargassum was observed but in its place considerable masses of Fucus were seen. In this weed we took a species of Balistes distinct from the one captured in the Sargassum.

The Intermediate Fauna.

The intermediate collecting was carried on chiefly by means of hauls with a five-foot open net of the ordinary "Albatross" pattern, coarse meshed, only the last three feet being lined with bolting silk. For general work of this sort the value of a large net cannot be overestimated, and it is equally important that at least most of its surface be of coarse mesh; otherwise the passage of water is too slow and the fabric soon becomes clogged. Apstein [1] has already observed that the ordinary fine plankton

[1] Salpen der deutschen Tiefsee-expedition. Wiss. Ergeb. der deutschen Tiefsee-expedition, Bd. 12, lief. 3, 1906.

net is of little service for collecting large organisms, and the same thing was experienced during the cruise of the "Albatross" in the Eastern Tropical Pacific in 1904–1905. The construction of the tail of the net should be such as to prevent its collapse with consequent injury to its contents. For this purpose a glass jar is often attached. But our experience on various expeditions has shown that it is quite as effective, and much more convenient, simply to insert between the bolting silk and outer covering a sleeve of brass wire-netting, sewing it to the outer net, and leaving enough stuff to tie up below it. This has answered every purpose, is cheap, and unbreakable.

The Tanner closing net was also employed at one station, but caught nothing. For work on a small sailing vessel such as the "Grampus," owing to the rapid rolling and pitching, this form of closing net is much more difficult to handle than on a large vessel. Even in calm weather a schooner lurches about so violently that it is often impossible to handle any heavy apparatus requiring delicate adjustment. For this reason the arrangement of the "trigger" on the Tanner net, which has been found entirely adequate on the "Albatross," was unsatisfactory, owing to its liability to trip, with consequent closing of the net, before the latter even reached the water. To obviate this difficulty, following the example of Murray [1] who experienced the same trouble, we lashed the long upright arm of the trigger to the wire rope with weak twine. This holds the trigger firmly, but, being readily cut by the messenger in its descent, offers no obstruction to the operation of the net. To the use of the Petersen net excessive rolling introduces another but equally serious drawback, namely, the possibility of the net opening while being lowered, when it is pulled upward through the water by the reverse roll of the vessel. A second drawback to this net is that it can be operated only through a comparatively short column of water, a fact which, together with the small diameter of the mouth, seriously reduces the amount of its catch.

During the Cruise intermediate hauls were made at nine stations with the five-foot open net at various depths down to about 300 fathoms and thence up to the surface, both by day and by night, and at one station with the Tanner net. The results of this work were most discouraging. Although the net always brought back a considerable mass of material, this consisted almost entirely of species of Salpae, fishes, schizopods, amphipods, copepods, ostracods, pteropods, and Sagittae, which were taken also on the surface or in hauls at depths from 15 to 50 fathoms.

[1] Geogr. Journ., **13**, p. 147, 1899.

It is evident, then, that the bulk of the catch was obtained by the net on its downward and upward trips through the surface zone. None of the genera of fishes, of crustaceans, of holothurians, nor of Medusae, which have been shown to be characteristic of the intermediate zone, were taken. This is the more remarkable in view of the fact that two intermediate genera of Medusae, Atolla and Periphylla, have both been taken frequently in the trawl from the region of the Gulf Stream. I am unable to explain this failure. It may be that we did not work deep enough, and this occurred to us during the Cruise, but inasmuch as our apparatus was not adapted to working at depths greater than 300 fathoms, we were unable to test this possibility. However, the experience of the "Albatross" expedition to the Eastern Tropical Pacific has demonstrated, for the region of the Humboldt current at least, that the intermediate fauna is abundantly represented in the zone above the 300-fathom line, and I see no reason to believe that the contrary would prevail in the Gulf Stream, a region in which, although temperate conditions are different, the nature of the food supply of intermediate organisms much resembles that in the Humboldt current. It is not improbable that had we worked a month later our success might have been greater.

In spite of the general poverty of the intermediate fauna, one new intermediate Medusa, a Sibogita, was taken. It is of interest not only from the systematic standpoint, but also from the circumstances of its capture. Sibogita was first taken at Station 3, where six specimens were captured in a haul with the five-foot net from 175 fathoms. At this point, which is on the coastal slope, the depth of water is about 260 fathoms, and from here the slope to the 1,000-fathom curve is rapid. Sibogita was not encountered again until Station 11, when, at about the same relative position on the slope, in a depth of 300 fathoms, another specimen was taken in a haul from 150 fathoms. The species was not met with again, although another haul was made near the locality where it was first captured. There is every reason to believe, from its near allies, that Sibogita passes through a fixed stage ; and from the present captures I believe that when discovered the hydroid will be found to be a deep-water form, living below 150 fathoms. The fact that this Medusa has never been recorded from Woods Hole or from Newport, in spite of the systematic collecting carried on for many years at both these localities, is no doubt due to its intermediate habitat, below the influence of the surface waters of the Gulf Stream which are often driven by southerly winds against the southern coast of New England.

THE MONACO DEEP-SEA TRAP.

The deep-sea trap which we employed was supplied by the United States Bureau of Fisheries, and in all respects resembled the pattern of the Prince of Monaco, except that the frame-work was constructed of galvanized iron gas pipe instead of wood. The use of the Monaco trap, like that of closing-nets, is difficult on a small vessel, but judging from the present Cruise the results which it may be expected to yield are more than commensurate with the trouble involved. I question, however, whether it possesses any superiority over the trawl, except in certain special cases. The chief difficulty on a vessel so small as the "Grampus" is the nature of the rope to be employed, if sets are to be made in depths of 500 fathoms or upward. Under these circumstances the five-eighths inch wire rope usually used in trawling is out of the question, for not only is it difficult to handle, but its great weight in water would require a float or buoy larger than could be carried. On the present trip, having no smaller wire rope, hemp "buoy line" was successfully employed; but it has the drawback of weakness, while its great frictional resistance to the water enormously increases the difficulty of hauling in the trap with a small motor. No doubt a very small wire rope, with breaking strain of about 800 pounds, would prove satisfactory. A larger one is unnecessary, since the weight of trap and sinker together need not exceed 100 pounds. The buoy should be provided with a flag of some sort on a light pole. For economy of time it would be advisable to have several traps and set them in lines; with such an arrangement there would be little danger of losing them, while the vessel might be employed with other work during the sets. For bait we used dead fish and table scraps.

In our two sets the results were as follows: at Station 3 the trap remained on bottom about one hour only. It brought back two species of fish, *i. e.*, eleven large *Myxine glutinosa*, and one *Synaphobranchus pinnatus*, as well as several specimens each of two species of large amphipods. At Station 12 the trap was on bottom for about two hours. It contained one *Synaphobranchus pinnatus*, one *Physis chesteri*, and twenty-one *Simenchelys parasiticus*. The latter species must be extremely abundant at this locality, to allow so many to find their way into the trap in so short a time, for they are but weak swimmers.

Temperatures.

The few temperatures observed during the voyage are of interest as additions to the records of the temperature conditions of the Gulf Stream. The highest surface temperature was 76°, the lowest within the sweep of the Stream, 72°. The most important feature of the observations is their renewed demonstration of the shallowness of the surface layer of warm water in this region. Thus at Station 5, where the highest surface temperature (76°) was observed, at 100 fathoms the temperature was only 49.5°, a drop of over 26°. And the highest temperature observed at 100 fathoms was only 51.5°. The temperatures are shown in the table, (p. 210).

Description of a New Medusa.

Bythotiaridae Maas, 1905.

sens. em. Bigelow, 1909.

This family is of such importance from its morphologic relations on the one hand to the Tiaridae and on the other to the Williidae, that a new species is of unusual interest. More especially is this the case since up to the present time only eight individuals (representing the genera Bythotiara Guenther, Heterotiara Maas, and Sibogita Maas) have been described which can certainly be referred to it, though two other genera, Dichotomia Brooks, and Netocertoides Mayer, may find their place here. The specimens collected by the "Grampus" are typical members of Sibogita.

Sibogita Maas, 1905.

sens. em. Bigelow, 1909.

Bythotiaridae with four primary radial canals, and in addition, numerous centripetal canals which may secondarily come to join either the cruciform base of the manubrium or the radial canals, or may remain blind. Gonads transversely folded.

Two species have previously been referred to this genus, *S. geometrica* Maas (the type), and *S. simulans* Bigelow, the first from the Malaysian region, the second from the west coast of America. From my studies on *S. simulans*[1] I maintained that the branching of the canals described by Maas in *S. geometrica* was a secondary condition, resulting from a union of blind centripetal canals with the cruciform base of the manubrium or with canals of an earlier generation. Inasmuch as a secondary junction of canals with manubrium probably occurs in *S. geometrica*, as well as in *S. simulans*, I believed that it was characteristic of the genus. In the present series, however, the centripetal canals all end blindly, although the specimens are apparently mature. This difference should not be

[1] Mem. Mus. Comp. Zoöl., **37**, p. 212, 1909.

made the basis for generic separation since it is merely a case of permanence in the Atlantic species of a character retained up to a very late stage in growth by the Pacific form ; and therefore a modification of my earlier (1909) generic characterization is necessary. In the condition of the canals the specimens are much more closely related to *S. simulans* than to *S. geometrica*, but they are separated from both not only by the permanently blind centripetal canals, but also by other characters of sufficient importance to warrant the institution of a new species.

Sibogita nauarchus, sp. nov.

Fig. 1-8.

Lat. 39° 49′ N. ; long. 70° 16′ W. ; 175 fathoms to surface, 6 specimens.

Lat. 39° 39′ N. ; long. 71° 48′ W. ; 150 fathoms to surface, 1 specimen.

The specimens all have well developed gonads, in which the sexual products are apparently mature.

In general external appearance *S. nauarchus* closely resembles *S. simulans*. The specimens are, however, larger than the three recorded individuals of the latter, the largest in the present series measuring 37 mm. in height by 40 mm. in diameter, as against 30 and 22 mm. respectively for the " Albatross " specimens of *S. simulans*. The single known specimen of *S. geometrica* is described by Maas [1] as being 38 mm. high by 30 mm. in greatest diameter. The general outline of the bell is rounded ; the gelatinous substance fairly thick and stiff. An important feature of *S. nauarchus* is the presence of a deep funnel-shaped apical depression, clearly shown in the type (Fig 1). This character must be regarded as normal, since it is well developed in all six specimens ; and since no corresponding structure occurs either in *S. geometrica* or in *S. simulans* it is no doubt of specific significance.

Both Maas and myself have already recorded a lateral flattening of the bell in Sibogita, whereby one diameter is much greater than the other ; and since such a flattening was observed in all the specimens of *S. nauarchus* before preservation it is probably normal. However, the plane in which the flattening occurs is not invariable, it being either radial or interradial. Thus, while in both the Eastern Pacific specimens of *S. simulans*, even before preservation, there was strong radial flattening (Bigelow, *loc. cit.*, pl. 5, fig. 5), in the present series the flattening is radial in two specimens, and interradial in 4. From this evidence it appears that the flattening is not a structural feature, but a contraction-phase which is readily assumed.

Manubrium. The manubrium, as in both previously known members of the genus, is barrel-shaped, about two-thirds as broad as long, and about one-half as long as the bell cavity is deep (Fig. 1), and it is readily distinguishable into basal, gastric, and labial portions. As in *S. simulans* it is cruciform basally (Figs. 2, 4).

Canal system and tentacles. The collection contains an interesting series of

[1] Die Craspedoten Medusen der Siboga-Expedition. Uitkom. op. Zool. Bot., Oceanogr. en Geol. Gebied. Siboga-Expeditie. Monogr. 10, p. 17. 1905.

stages in the development of the canal system and tentacles. The number of radial canals in each of the specimens is 4, but the number and degree of development of the blind centripetal canals, such an important feature in this genus, varies, not only in different individuals but in the different quadrants of any one individual. The most rudimentary condition in any quadrant is one in which there are three blind canals, one interradial and two adradial, the interradial, which is the furthest developed, reaching nearly to the base of the manubrium (Fig. 1). Connected with each canal is a well-developed tentacle, as is shown in the photograph, and between the interradial and one of the adradial tentacles is an extremely rudimentary tentacle as yet unconnected with a canal (Fig. 3). From this, as well as from similar instances, it is evident that in the development of additional tentacles and blind canals, the tentacle is formed first, its corresponding canal appearing later. In all quadrants the largest blind canal is the interradial, a fact showing that it is formed next after the radial canals. After the formation of these three series, radial, interradial, and adradial, further development of canals and tentacles is somewhat irregular. The numbers of canals and tentacles per quadrant, together with the dimensions of the bell, are given for five specimens in the subjoined table.

Height mm.	Diameter mm.	Tentacles between each two radial tentacles	Blind canals in the corresponding quadrants	Flattening of the bell
33	35	4, 5, 5, 6	4, 4, 4, 3	interradial
32	35	5, 5, 4, 5	3, 4, 3, 4	interradial
30	32	6, 5, 5, 5	3, 4, 5, 4	radial
37	40	5, 5, 6, 5	4, 4, 5, 4	interradial
37	39	5, 4, 4, 5	5, 4, 4, 4	radial

One abnormality was observed in which there are two blind canals in connection with a single tentacle (Fig. 7). The greatest number of tentacles in any quadrant is six; though in this quadrant only three canals are present. The greatest number of blind and radial canals and of tentacles in any individual is twenty-one and twenty-five, respectively, in the largest specimen. None of the canals unite with the manubrium in any specimen, nor are any of them branched. The blind terminations of the canals are ordinarily simply rounded (Fig. 4); in several instances, however, they are variously lobed and dentate (Fig. 2), and it is possible that such a conformation foreshadows a future union with the cruciform base of the manubrium. In the condition of its tentacles and centripetal canals *S. nauarchus* closely resembles half grown specimens of *S. simulans*, except that in the former the number of these organs is slightly greater than in the latter. But, as I have already pointed out (p. 205) the centripetal canals in *S. nauarchus* are probably permanently blind, whereas in *S. simulans* they come, through growth, to join the cruciform base of the manubrium. In *S. geometrica* conditions in the adult, which alone is known, indicate that not only do the older generations of centripetal canals join the base of the manubrium but the youngest centripetals join the earlier formed canals, both radial and centripetal, at varying heights.

Tentacles. — In structure the tentacles resemble those of *S. simulans;* their better preservation allows confirmation of my previous description. They are hollow, distensible to a length considerably greater than the bell height, and when fully developed each bears at its tip a conspicuous nematocyst knob (Fig. 8). The tentacles do not acquire this structure until fully grown. A similar terminal knob was observed in *S. simulans* (Bigelow, *loc. cit.*, p. 215), and it is probable from Maas's description that it occurs in *S. geometrica.* The basal swellings are small (Fig. 3). In the appearance of the young tentacles in advance of the corresponding canals, *S. nauarchus* agrees with *S. simulans.* There are no ocelli, nor have ocelli been observed in this genus.

The tentacles, as in both *S. simulans* and *S. geometrica*, appear to arise from the exumbrella some little distance above the actual margin of the bell. This position, however, is only secondary, and is comparable to the exumbral origin of the tentacles in the Olindiinae. The youngest tentacles stand free upon the margin (Figs. 5–7). With growth, however, this primary position is concealed, for the tentacles turn outward and upward, coming to lie in furrows of the exumbrella, so that they apparently emerge from the surface of the bell some distance above its margin. In *S. nauarchus,* at least, their bases never become entirely surrounded by the gelatinous substance of the bell, as is the case in the Olindiinae, but the exumbral furrows remain permanently open.

Gonads. — The gonads in all the specimens are far advanced, large eggs being visible in two individuals. In their main features they closely resemble those of the two members of the genus previously known, being strictly interradial, entirely discontinuous in the perradii, and consisting of double series of narrow and rather regular transverse folds (Fig. 2). In addition to these transverse folds irregular projecting lobes are developed in three specimens (Fig. 1). Sections, however, show that such lobes are nothing more than regions of the sexual organ which have made an irregular growth outward. The sexual organs are entirely restricted to the walls of the manubrium; they leave the labial region of the latter bare.

Color. — In life the gonads were deep brownish red, the terminal tentacular knobs and basal bulbs pale yellowish.

The evidence that *S. nauarchus* belongs to the intermediate fauna, and that it is probably liberated from a deep-water hydroid, has already been given (p. 203).

S. simulans was taken on the surface; *S. geometrica* is known only from an intermediate haul.

S. nauarchus is separated from *S. geometrica* by the fact that in the adult of the latter there are only sixteen tentacles, though there are thirty-two canals, whereas in *S. nauarchus* the number of tentacles equals that of canals or, since young tentacles are formed before the corresponding blind canals, may be slightly greater. From *S. simulans*, to which it is more closely related, it is separated by its greater size, and by a larger number of tentacles and canals. It is, moreover, readily distinguished from both previously known species by the presence of the apical depression of the exumbrella, as well as by the permanently blind terminations of the centripetal canals.

TABLE OF STATIONS.

Station	Date	Time	Latitude N.	Longitude W.	Surface temperature	Temperature at	Depth by sounding	Bottom	Nature of haul
1	1908 July 9	3 P.M.	40° 2′	70° 23′	...	....	200	grn. mud. few glob.	Sounding
2	" 9	4 P.M.	39° 55′	70° 19′	...	....	200	grn. mud.	Sounding
3	" 9	5 P.M.	39° 49′	70° 16′	71°	100 fms. 51.5°	260	few glob.	Monaco trap 5 ft. open net at 175 fms. and to surface
4	" 10	8 A.M.— 12 M.	39° 20′	70° 26′	74°	100 fms. 49°	..	....	Tanner closing-net at 275 fms. 5 ft. net at 275 fms. and open to surface
5	" 10	6 P.M.	38° 40′	70° 4′	76°	100 fms. 49.5°	..	....	5 ft. net at 275 fms. and open to surface Surface haul
6	" 11	6 A.M.	38° 33′	70° 8′	75°	400 fms. 42.5°	..	....	5 ft. net at 300 fms. and open to surface
7	" 11	2 P.M.	39° 9′	70° 39′	74.5°	....	..	....	5 ft. net at 150 fms. and open to surface
8	" 11	8 P.M.	39° 24′	71° 14′	74°	....	..	....	Surface haul
9	" 12	10 A.M.	39° 25′	71° 48′	75°	....	..	....	Surface haul 5 ft. net at 300 fms. and open to surface
10	" 12	2 P.M.	39° 36′	72° 15′	75°	....	51	grn. mud. few glob.	Sounding
11	" 12	6 P.M.	39° 39′	71° 48′	75°	300 fms. 42°	300		Sounding
—	" 13	8 A.M.	40° 1′	70° 54′	73°	200 fms. 46°	200	grn. mud. few glob.	5 ft. net at 150 fms. and open to surface Sounding
—	" 13	....	....	....	...	190 fms. 46.5°	190	....	Sounding
12	" 13	3 P.M.— 8 P.M.	39° 54′	70° 44′	75°	....	455	grn. mud. glob.	Sounding Monaco trap 5 ft. net at 200 fms. and open to surface
13	" 14	2 A.M.	39° 57′	70° 13′	72°	....	..	....	5 ft. net at 100 fms. and open to surface Surface haul
14	" 14	8 A.M.	40° 7′	69° 55′	71°	....	75	grn. mud. sand	5 ft. net at 50 fms. and open to surface
15	" 14	3 P.M.	40° 33′	69° 44′	64°	31 fms. 44.5°	31		5 ft. net at 15 fms. and open to surface Surface haul
—	" 14	5 P.M.	....	....	54.5°	....	..	....	Surface temperature Surface collection
16	" 15	7 A.M.	41° 20′	69° 10′	65°	....	70	broken shells	5 ft. net at 50 fms. and open to surface